Decision Maker and Stakeholder Guide

Managing Magnetic Fields in California Public Schools

Submitted by

Brock Bernstein and H. Keith Florig
Principal Investigators

Laurie Geisinger, Max Henrion, John Jostes, Asher Sheppard
Co-investigators

to

California Department of Health Services
and the
Public Health Institute
1515 Clay Street, 17th Floor
Oakland, CA 94612

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Contract Officers:

Raymond R. Neutra, M.D., Dr.P.H.
Chief, California EMF Program and Div. of
Environmental & Occupational Disease Control

Vincent Delpizzo Ph.D.
Director of Extramural Research
California EMF Program

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Introduction

Studies of the possible health effects of electromagnetic fields (EMFs) from the electric power system[1] have been ongoing for almost 30 years. Although scores of studies have been completed on laboratory animals, cells, and human populations, unassailable evidence that EMF exposure is harmful has yet to emerge. In 1993, the California Public Utilities Commission (CPUC) instructed the public utilities in California to support a research and public education program (CPUC decision 93-01-013) on possible deleterious health effects of EMFs associated with the electric power system. The CPUC authorized the California Department of Health Services (CDHS) to carry out this program. The studies undertaken by this program (see http://www.dhs.ca.gov/ehib/emf) address a range of scientific and public policy questions relating to possible EMF risks. One of the policy areas addressed by the CDHS program is what to do about EMF exposure in California's 7,700 public schools. CDHS launched its "Schools Policy Project" because of the high value that society places on the safety of schools, and because of the growing number of schools at which parents had raised EMF health concerns.

This Guide is intended to help stakeholders and policy makers (state officials, school board members and legislators) to interpret and apply the results of the Schools Policy Project, a multi-year effort to develop and analyze alternatives to managing magnetic fields in California's public schools. The Project has four main products. The first, a main report[2] with executive summary, identifies policy options for managing school-time EMF exposure at the statewide level and describes alternative frameworks for analyzing these options. The second, a computer model called EMF_SCHOOL, allows stakeholders and decision makers to explore the statewide costs and benefits of magnetic field-strength standards for schools under a variety of assumptions.[3] The third (this document) is a brief orientation for stakeholders and decision makers to using the first two products. The fourth, a report on the social costs of a variety of diseases possibly

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[1] Power system EMFs arise from many indoor and outdoor sources including appliances, lighting fixtures, building wiring, transmission and distribution lines, electrical panels, and transformers. Although the term "electromagnetic field" technically refers to both electric and magnetic fields, concern about health effects has focused almost exclusively on exposure to magnetic fields. In this report, we use the term "EMF" to refer only to magnetic fields.

[2] Bernstein, B., Florig, H.K., et al., "Managing Magnetic Fields in California Public Schools," California Department of Health Services, Oakland, CA, September, 2001.

[3] Florig, H.K., "EMF_SCHOOL: A Decision Tool for Magnetic Field Standards in California Schools," California Department of Health Services, Oakland, CA, 2001.

associated with EMF exposure,[4] provides background information to support analyses in the first two products.

What ethical world views will you encounter in making EMF policy for schools?

Differences of opinion over EMF policy arise as much from differences in the ethical worldviews people hold as from differences in opinion concerning the probability that EMF exposure is harmful. Those who subscribe to a utilitarian worldview, who are primarily concerned about getting the most risk reduction for each dollar invested, would not correct situations involving exposure to strong magnetic fields if the costs of field reduction were high. Utilitarians also focus on the most good for the most people even if this means ignoring the high risk of a minority of people. Those who subscribe to a Social Justice worldview, who are primarily concerned about the fairness of a policy, would first address situations involving those at highest risk, even if the cost is very high. Still others would argue that no money should be spent on EMF risk reduction until the science is much more certain, contending that any funds for making children safer should be applied first to school risks that are well understood (i.e., injuries from school sports, infectious diseases), yet not adequately controlled. Libertarians would tend to endorse only those options that are voluntary and not imposed by government.

Differences in worldviews can affect not only opinions about whether and where to reduce EMF exposure, but also who should pay. Possible sources of revenue for addressing EMF in schools include taking funds from other school programs, grants from the State with revenues generated by an electricity tax, grants from the local utility, additional school tax levies, or special local bond initiatives. Utilitarians would argue that the money should come from those who will hurt the least by giving it, i.e., the rich. Social Justice adherents would argue that everyone except the poor should pay. Libertarians would argue that only those who wish to pay should do so (i.e., a voluntary contribution program).

Sometimes, the worldviews that people espouse are related to whether or not they will have to pay to apply their values. It is easier to support a Social Justice point of view, dismissing cost

[4] Sheppard, A.R., Kelsh, M.A., Florig, H.K., "Health-Related Costs that May be Attributable to Electric and Magnetic Field Exposures in California Public Schools", California Department of Health Services, Oakland, CA, May 26, 1998.

as a concern, if someone else will pay those costs. In order to reduce their cost burden, the group that is called on to bear the most cost may adopt a Libertarian or Utilitarian stance, or may demand that there be unanimous scientific consensus on health effects before acting.

Because these differences in values can greatly affect the attractiveness of one or another policy, the Schools Policy Project has endeavored to present our results from a number of different perspectives. Section 3 of the Main Report elaborates on this point.

Many key questions of EMF policy for schools are fundamentally ethical worldview issues. Examples include:

- Should schools in low SES neighborhoods be fixed first, even if more ill health might be averted by fixing the most cost-effective opportunities first?
- Should situations involving high-field exposures be fixed first, even if more ill health might be averted by fixing more cost-effective opportunities first?
- Who should pay for EMF reductions in schools? All taxpayers? All electricity users? Just those with school children? Just those whose children are exposed? Just those who want to pay? Just electric utilities?

In coming to a conclusion about what, if anything, to do about EMFs, education officials, legislators or school board members will have to preside over a process where these different worldviews are accommodated as courses of action are selected. As policy debates unfold over EMF in schools, it is important to recognize when people are arguing facts and when they are arguing values. By explicitly addressing the value content of such questions early in the policy process, decision makers can help to avoid confusion in the policy discourse.

What are some other top-level questions that decision makers face?

In addition to questions of what ethical worldview(s) to apply to the EMF-in-schools decision, there are a number of other high-level questions that must be answered before discussion can proceed to specific policy design. The answers to these questions help to constrain the domain of possible policy options under consideration. The most important of these questions are as follows:

EMF or all school risks? Should the EMF-in-schools problem be treated in isolation or in the larger context of all health and safety risks in schools? If the latter, policy makers might

choose to dismiss EMF risks for the present, and instead take measures to reduce larger or easier to mitigate hazards that children face in schools. In order to implement a policy to address all school risks, there must be funding and administrative mechanisms common to all risks. Such mechanisms do not currently exist, but might be arranged through the California Department of Education and the State legislature.

School or home risks? Does the fact that magnetic field levels in schools are, on average, comparable to magnetic field levels in homes, reduce the need to attend to schooltime exposures? We argue that there is nothing inconsistent about treating school exposures independent of exposures at home. The latter are not under state jurisdiction. Historically, environmental risks in the home (e.g. environmental tobacco smoke, radon, lead) have been addressed with information strategies, not with mandates. By contrast, risks in schools (e.g. asbestos, lead) have been treated quite aggressively.

Now or later? Given the uncertain nature of EMF risk, and given that research on EMF exposure and biological effects continues to unfold around the world, it is reasonable to ask whether California might be better off waiting for better information before investing in EMF reduction in schools. We examine this question in some detail in our policy model for exposure standards (described in Section 6 of the Main Report). We find that waiting before mitigating even the least costly source of EMF exposure (net currents) can be justified on cost-benefit grounds if one believes that there is less than a 30% probability that EMFs cause less than a doubling of leukemia risk. As that probability becomes greater than that, or as confidence increases that other diseases may be affected, it may be justifiable on a cost benefit basis to begin abating some sources now, even without absolute certainty. These conclusions are based on the assumption that risk reductions predicted using long-term average magnetic field are roughly predictive of the risk reductions that would actually occur if field strength reductions were undertaken. This is not necessarily the case, since risk may be only partially affected by measures that reduce long-term average magnetic field strength. The computer model, EMF_SCHOOL, allows users to explore the possibility that reducing average magnetic field strength is only partially effective at reducing risk.

All sources or fewer? If the decision domain is restricted to possible EMF risks, then the question arises concerning what sources of EMF are the best targets for possible regulatory action. EMF sources in schools include internal building wiring, a variety of electrical appliances, and external power lines. Each of these sources is managed through different channels, each has different "owners," and each lies in a potentially different regulatory domain. Moreover, the cost per unit exposure reduction to reduce EMF exposure from some sources is dramatically less than that for other sources. Should analysis be done from the point of view of a super-authority with jurisdiction over all sources, or should regulatory options be considered separately for each source type? Selecting less than all source types for attention may be viewed as unfair, even if the sources that are not targeted are the most expensive sources to manage.

New and/or existing facilities? Because EMF problems associated with new facilities can be eliminated at the time of siting, design, or construction, it is often quite cheap to do so. For instance, siting guidelines can be used to limit exposures to existing power lines, and electrical inspection guidelines can be used at the time of construction to eliminate net currents. In contrast, modifying conditions at existing schools or power lines often involve more costly measures. So the question arises whether or not to "grandfather" existing facilities, or at least those classes of sources (e.g., transmission lines) that are most expensive to fix. Temporary grandfathering can be used as part of a wait-and-see strategy in which EMF problems at existing schools would be fixed only if the uncertainty over EMF health effects was significantly reduced.

How did the Schools Policy Project accommodate different methods of analysis?

Everyone approaches decision making a little differently. Utilitarians like detailed analysis, with quantitative estimates of the costs and benefits of each alternative. These analyses are lengthy and can be so technical that they are not easy to follow. Others prefer a more holistic and qualitative comparison of alternatives. By their nature, the latter are briefer and understandable by most people. The Schools Policy Project adopts both approaches, but has devoted more space to quantitative analysis of costs and benefits. This allows the complicated problem of what to do about EMF in schools to be decomposed into a series of more tractable

questions. For instance, the question of whether or not to implement a magnetic field level standard for schools can be broken down into a series of simpler questions:

1. What is the probability that magnetic field exposure causes health damage?
2. If magnetic fields exposure has deleterious health effects, how much health damage can be avoided by reducing magnetic field levels in schools?
3. How much should society be willing to pay to eliminate those health effects, if they are real?
4. How much does it cost to reduce magnetic field exposure in schools?

Under a cost-benefit decision analytic framework, one would choose to implement a magnetic field standard only if the cost of implementing the standard is less than the willingness to pay to avert the health effects multiplied by the probability that those health effects exist. The first two of the above questions are addressed in a recently published risk evaluation by CDHS (see www.dhs.ca.gov/ehib/emf/research4.html#RE). The third question is covered in Section 6.7.6 of our Main Report, which discusses alternatives for valuing reductions in disease burden (i.e., willingness to pay). Answers to the last of these questions can be found in both the EMF_SCHOOL model and in Section 6.7.4 of our Main Report.

Some people are not comfortable with quantitative cost-benefit analysis. They question whether one can place a monetary value on disease. They question whether quantitative models themselves are undemocratic because they exclude those who are not trained in quantitative methods. While these are legitimate points, those who prefer more qualitative approaches may still want to review the quantitative analyses of this project, both to gain insights for themselves and to challenge assertions of other stakeholders who use quantitative arguments to advocate certain courses of action. Likewise, those who lean toward quantitative analysis may want to consider the various qualitative attributes of policy alternatives described in Sections 3 and 5 of the Main Report.

What use is the Schools Policy Project's computer model of the costs and benefits of magnetic field standards?

Given that policy makers will need to obtain support from stakeholders using different ethical world views to form any policy, it is important to ask what role, if any, the EMF_School computer model might play in the process, particularly given the fact that it is a cost-benefit type

of model appealing only to some of the world views. The most important application of the computer model EMF_SCHOOL is to explore how various decision variables depend on assumptions. As stakeholders try to decide what to do, arguments typically arise about what things cost, how extensive exposure really is, or how much risk there is. Sometimes these arguments about facts are crucial to choosing a course of action, sometimes they turn out not to be as influential as first believed. The computer model allows one to see how crucial these factual assumptions really are. The model can show, for instance, how the health benefits of an exposure-reduction policy depend upon assumptions that are made concerning the probability that a given disease is caused by EMF, how the costs of a policy depend on assumptions concerning the number of schools situated close to power lines, and how the net benefits of a policy depend on society's willingness-to-pay to avert each case of an EMF-caused disease. Another important application of the computer model is to explore how health benefits and costs of an exposure reduction policy depend on the amount of exposure reduction that is desired (i.e., whether an exposure standard is set at 5 milligauss (mG) or 2 mG. Finally, the model can be used to explore the benefits (or unwanted consequences) of delaying implementation of magnetic field standards until more information is available on EMF health effects. A software product called "Analytica" is required to run the model. A version of Analytica may be downloaded for free on the web at www.lumina.com. This free version cannot be used to create new models, but will work fine for running EMF_SCHOOL.

Those needing assistance in running EMF_SCHOOL should contact CDHS EMF Program Staff who can provided limited support themselves, or can provide a list of consultants that can be contacted for more detailed help. Stakeholders with limited resources may find pro-bono help from graduate students or professionals with a background in economics, policy analysis or business administration.

Note that EMF_SCHOOL is configured to estimate statewide health benefits and costs of field strength standards. The model cannot be used to estimate benefits and costs for any particular school, but might provide insights to a large school district.

What findings of the School Policy Project are most relevant to local school districts?

The School Policy Project was designed to develop and assess policy alternatives at the State level. Nonetheless, there are a number of findings from the project that can be useful to local officials. These are as follows:

- Based on current evidence, in 1998 the National Institutes of Environmental Health determined that childhood and adult leukemia were "possibly" caused by EMF exposure while they deemed the evidence for other diseases to be "inadequate". In 2001, the International Agency for Research on Cancer deemed only the evidence for childhood leukemia to warrant a classification of "possibly carcinogenic." The California EMF Program, of which this project is a part, will publish its own evaluation in 2002. Based on cost-effectiveness considerations, the EMF_SCHOOL model suggests that modest degrees of confidence about leukemia could warrant dealing with the most common source of high fields in schools (net currents). The absolute risk that would thus be avoided in an individual school, however, is very small, just as the risk of violent death in any individual school is very small. If, as suggested by epidemiologic studies, chronic exposure to an EMF level of 2 mG were to double the rate of leukemia in children (compared to the rate in unexposed children), then the increased mortality from leukemia in a school of 1,000 students and staff exposed to school time fields of 2 mG would be roughly one death every 200 years. These risks are smaller than some other health and safety risks that children encounter in school. In a school of 1,000, for instance, one would expect one death from commuting to and from school every 14 years, one death from a school-contracted infectious disease every 100 years, and one death from violence-related injury every 1,000 years. This project cannot provide guidance to prioritize these problems, because it has not explored the costs and benefits of addressing these other hazards.
- Some school-time EMF risks can be eliminated at relatively modest cost. Of the major sources of EMF exposure in schools (e.g., power lines, net currents, electrical panels, etc.), EMF exposure from net currents is the most common and most cost-effective to fix. Net current problems can often be located and eliminated at costs of less than a

few thousand dollars per school and at costs of tens to hundreds of thousands of dollars per disease case avoided. Net currents are usually caused by wiring practices that violate the National Electrical Code. In addition to creating magnetic fields, these code violations can increase the risk of fire, electrical shock, and electrical damage to electronic equipment such as computers.

- A large problem for local school officials is finding some way to pay for reducing magnetic fields within the schools in their district, should they wish to do so. Some of the discussion in Section 7 of the Main Report may be useful to understanding this issue.

How Should Policy Makers at the State or School District Proceed?

Knowledgeable scientists are not unanimous as to their degrees of confidence that EMFs might contribute to the cause of various diseases. The decision making body has to first decide if they are willing to take any action before the evidence has advanced to the point where all scientists agree. If the decision-makers are willing to take any avoidance actions under uncertainty, then we recommend the following process for their consideration:

- Identify and convene the stakeholders in your jurisdiction who care about the issue. Be prepared for a number of meetings.
- Get the group to review this document and the executive summaries of the school policy project, the recent IARC risk evaluation, and the upcoming CDHS-EMF Program Risk Evaluation.
- Ask the group to explore what ethical worldviews they would apply to the situation. If there are differences within the group, explore how these differences will affect preferred solutions and move on.
- Ask the group to discuss the “top level questions” in this document and the exposure reduction options and information options discussed in the main report.
- If factual arguments arise, obtain a consultant to help explore them using the EMF_School computer model.

- Ask the group to identify courses of action that they can all agree on, and a list of options about which there is no consensus, with reasons for the disagreement.
- Get the group to discuss how any actions might be funded, and what other activities should be stopped in order to obtain the money.
- Hold public hearings to summarize the groups findings and obtain broader input
- Make a decision.